WHAT IS CLAIMED IS:

1. An illuminating system, comprising:

an electrical interconnection plate with an array of electrically conductive circuitry arranged for interconnecting one or more LED chips to positive and negative voltage sources;

an array of LED chips, said LED chips equally sized and spaced from each other a distance S that is less than or equal to width W of said LED chip;

an array of metallically reflecting bins whose center to center spacing is equal to W + S, each said bin comprising a clear output aperture and a clear input aperture formed by one or more tapered metallically reflecting sidewalls extending between them;

a first light redirecting means disposed beyond said array of metallically reflecting bins that transmits light in a first angular range and reflects light in a second angular range back towards said array of bins;

a second light redirecting means disposed beyond said first light redirecting means that transmits light in a first angular range and reflects light in a second angular range back towards said first light redirecting means; and

said array of LED chips bonded electrically to said array of electrically conductive circuitry on said electrical interconnection plate, said array of metallically reflecting bins disposed just above said electrical interconnection plate such that every said LED chip in said array of LED chips extends in and through the center of every said input aperture.

2. The illuminating system as defined in claim 1 wherein all said LED chips in said array of LED chips either have both their positive and negative contacts on the same surface or their positive and negative contacts on opposing surfaces.

3. The illuminating system as defined in claim 2 wherein all said LED chips in said array of LED chips emit light in either the same wavelength range, mixtures of red, green and blue wavelength ranges, or are all white-emitting LEDs.

4. The illuminating system as defined in claim 2 wherein all said LED chips in said array of LED chips are made with an optically transparent substrate in the wavelength range or ranges emitted by said LED chip.

5. The illuminating system as defined in claim 1 wherein said array of metallically reflecting bins have plane tapered sidewalls slanting at angle γ from a line perpendicular to both said clear input and output apertures, each said clear aperture being square or rectangular in shape and related geometrically by the expression $\tan\gamma=(1/D)(X_o-X_i)/2$, where D is the depth of said array of metallically reflecting bins, X_o is the edge length of an edge of said clear output aperture, and X_i is the edge length of said clear input aperture.

6. The illuminating system as defined in claim 5 wherein said clear input and output apertures are each sized between 1.05 and 1.2 mm and 1.5 and 1.7 mm respectively on their edges, and said depth of said array of metallically reflecting bins D is between 170 and 180 microns.

7. The illuminating system as defined in claim 5 wherein the edge length X_i of each said clear input aperture is sized by $X_i = (f)(W)$, the fit factor f ranging from about 1.01 to about 1.3, f being the minimum factor needed to permit any said LED chip to fit through any said clear input aperture without mechanical interference.

8. The illuminating system as defined in claim 5 wherein said array of metallically reflecting bins are formed in plastic, glass, ceramic, metal or composite parts by molding, embossing, casting, or electroforming from a form-tool fashioned by diamond machining, said tapered metallically-reflecting sidewalls over-coated with a high-reflectivity metal film.

9. The illuminating system as defined in claim 8 wherein said high-reflectivity metal film is protected silver.

10. The illuminating system as defined in claim 5 wherein said array of metallically reflecting bins are formed by photolithographic methods in a material whose thickness approximately equals said depth of said array of metallically reflecting bins directly.

11. The illuminating system as defined in claim 1 wherein said array of metallically reflecting bins are filled with a transparent dielectric medium making optical contact with said metallically reflecting sidewalls and with the exposed sidewalls and surfaces of said LED chips.

12. The illuminating system as defined in claim 11 wherein said transparent dielectric medium has a refractive index for the wavelength emitted by said LED chip in the range 1.4 to 1.65.

13. The illuminating system as defined in claim 1 wherein metallic coatings on said array of metallically reflecting bins provides a common electrical conduction path for interconnection with either the positive or negative side of said LED chips when said LED chips have electrical contacts on both their upper and lower surfaces.

14. The illuminating system as defined in claim 1 wherein metallic coatings on the back surface of said array of metallically reflecting bins provides isolated electrical conduction paths for interconnecting the positive and negative sides of said LED chips when said LED chips have electrical contacts on the same surface.

15. The illuminating system as defined in claim 1 wherein said first and second light redirecting means are optically transparent films or sheets whose upper surfaces are structured with parallel and contiguous prismatic grooves, the full angle of each prism apex being a constant angle selected from within the range of 88 and 108 degrees.

16. The illuminating system as defined in claim 15 wherein said first and second light redirecting means are optically transparent films or sheets whose lower surfaces are lenticularly structured with parallel and contiguous cylinder lenses.

17. An optical system, comprising:

a liquid crystal display device whose rectangular aperture has length L and width W;

a condensing system of effective focal length F;

a planar light source array of equal length and width L' comprising a regular array of contiguous reflecting bins, said reflecting bins each comprising a clear output aperture and a clear input aperture formed by one or more tapered metallically-reflecting sidewalls

extending between them, each said reflecting bin containing one or more LED chips whose emitting surfaces protrude through said clear input aperture;

a first light redirecting means disposed beyond said array of reflecting bins that transmits light in a first angular range and reflects light in a second angular range back towards said array of bins;

a second light redirecting means disposed beyond said first light redirecting means that transmits light in a first angular range and reflects light in a second angular range back towards said first light redirecting means;

a first polarization converting means comprising a quarter-wave phase retardation film

a second polarization converting means comprising a polarization-selective reflecting film;

said condensing system, and said planar light source array oriented parallel to each other on planes orthogonal to a commonly centered optical axis, said LCD oriented either parallel or perpendicular to said commonly centered optical axis, the separation distances between said condenser system and each said LCD and said planar light source array being approximately equal to said effective focal length F of said condensing system, adjusted for the actual length within the dielectric material (if not air) occupying the spaces in between the elements; and

said first light directing means disposed above said reflecting bins by a gap thickness that includes air and the thickness of said array of reflecting bins, said second light redirecting means disposed beyond said first light directing means by an air gap thickness, said first polarization converting means disposed beyond said planar reflecting bins and said second polarization converting means disposed beyond said first polarization converting means.

18. The optical system as defined in claim 17 wherein said LED chips are attached to and interconnected by electrically conductive circuitry on a common heat conducting substrate.

19. The optical system as defined in claim 18 wherein said LED chips have both positive and negative electrodes on the same surface plane.

20. The optical system as defined in claim 19 wherein said positive and negative electrodes behave as metallically reflecting mirrors.

21. The optical system as defined in claim 18 wherein said LED chips in said planar light source array all have a common emitting wavelength range, have a mixture of chips, one fraction emitting in the red wavelength range, one fraction emitting in the green wavelength range and one fraction emitting in the blue wavelength range, or each emitting over a wide spectrum of wavelengths visually equivalent to white.

22. The optical system defined in Claim 17 wherein said plane tapered sidewalls are slanting at angle γ from a line perpendicular to both said clear input and output apertures, each said clear aperture being square or rectangular in shape and related geometrically by the expression $\mathrm{Tan}\gamma=(1/D)(X_o-X_i)/2$, where D is the depth of said array of metallically reflecting bins, X_o is the edge length of an edge of said clear output aperture, and X_i is the edge length of said clear input aperture.

23. The optical system as defined in claim 22 wherein said clear input and output apertures are each sized between 1.05 and 1.2 mm and 1.5 and 1.7 mm respectively on their edges, and said depth of said array of metallically reflecting bins D is between 170 and 180 microns.

24. The optical system as defined in claim 22 wherein the edge length X_i of each said clear input aperture is sized by $X_i = (f)(W)$, the fit factor f ranging from about 1.01 to about 1.3, f being the minimum factor needed to permit any said LED chip to fit through any said clear input aperture without mechanical interference.

25. The optical system as defined in claim 22 wherein said array of metallically reflecting bins are formed in plastic, glass, ceramic, metal or composite parts by molding, embossing, casting, or electroforming from a form-tool fashioned by diamond machining, said tapered metallically-reflecting sidewalls over-coated with a high-reflectivity metal film.

26. The optical system as defined in claim 25 wherein said high-reflectivity metal film is protected silver.

27. The optical system as defined in claim 22 wherein said array of metallically reflecting bins are formed by photolithographic methods in a material whose thickness approximately equals said depth of said array of metallically reflecting bins directly.

28. The optical system as defined in claim 17 wherein said array of metallically reflecting bins are filled with a transparent dielectric medium making optical contact with said metallically reflecting sidewalls and with the exposed sidewalls and surfaces of said LED chips.

29. The optical system as defined in claim 28 wherein said transparent dielectric medium has a refractive index for the wavelength emitted by said LED chip in the range 1.4 to 1.65.

30. The optical system as defined in claim 22 wherein every said plane tapered sidewall slants at angle γ between 30 degrees to 60 degrees of line perpendicular to both said clear input and output apertures.

31. The optical system as defined in claim 17 wherein said first and second light redirecting means are optically transparent films or sheets whose upper surfaces are structured with parallel and contiguous prismatic grooves, the full angle of each prism apex being a constant angle selected from within the range of 88 and 108 degrees.

32. The optical system as defined in claim 31 wherein said first and second light redirecting means are optically transparent films or sheets whose lower surfaces are lenticularly structured with parallel and contiguous cylinder lenses.

33. The optical system as defined in claim 31 wherein said first and second light redirecting means are made free of birefringence.

34. The optical system as defined in claim 31 wherein some output light is spread over all angular directions with substantially greater fraction of said output light linearly polarized and contained within said first angular range by means of cooperative action

between said LED chips, said tapered metallically-reflecting sidewalls, said first and second light redirecting means, and said first and second polarization converting means.

35. The optical system as defined in claim 34 wherein linearly polarized output light results from the conversion of substantially un-polarized input light emitted by said LED chips brought on by division into light of a first and second linear polarization state by said second polarization converting means, said first linear polarization state transmitted towards said condensing element as output and said second linear polarization state reflected through said first polarization converting means and converted to light of a first circular polarization state that is then changed to light of a second circular polarization state by its making an odd number of reflections with said LCD chip and said tapered metallically-reflecting sidewalls before returning back through said first polarization converting means and converting to light of said first linear polarization state as an additional part of said output.

36. The optical system as defined in claim 17 wherein said condensing system is at least one of spherical or aspherical bulk, Fresnel or diffractive lens element.

37. The optical system as defined in claim 36 wherein the clear aperture, CA, of said condensing element approximately equals the sum of the corner-to-corner length of said LCD and the corner-to-corner length of said planar light source array.

38. The optical system of claim 17 wherein the space between said LCD and said condensing element contains one of (a) air, (b) a block of optically transparent glass or plastic material composed of two 90-degree prisms optically-coupled to each other on their hypotenuse faces by a polarization-selective coating and one or more coatings of non-birefringent optical adhesive, non-birefringent acrylate, or UV curable epoxy, so as to form a polarizing beam splitter, (c) a block of optically transparent glass or plastic material composed of four 90-degree prisms optically-coupled to each other on their four hypotenuse faces two different dichroic coatings so as to form a dichroic color mixing element, (d) a group of optically coupled and dichroically coated prisms, and (e) a multi-layered plate tilted at approximately 45-degrees to said commonly centered optical axis.

39. The optical system of claim 38 wherein said multi-layered plate contains one or more of each of the following parallel and optically coupled elements: (a) a thin flat glass plate, (b) a polarization-selective reflecting material, and (c) an absorption polarizer material.

40. The optical system of claim 17 wherein said LCD is either (a) transmissive, or (b) reflective in its mode of operation.